Risk factors for SSI after open heart surgery

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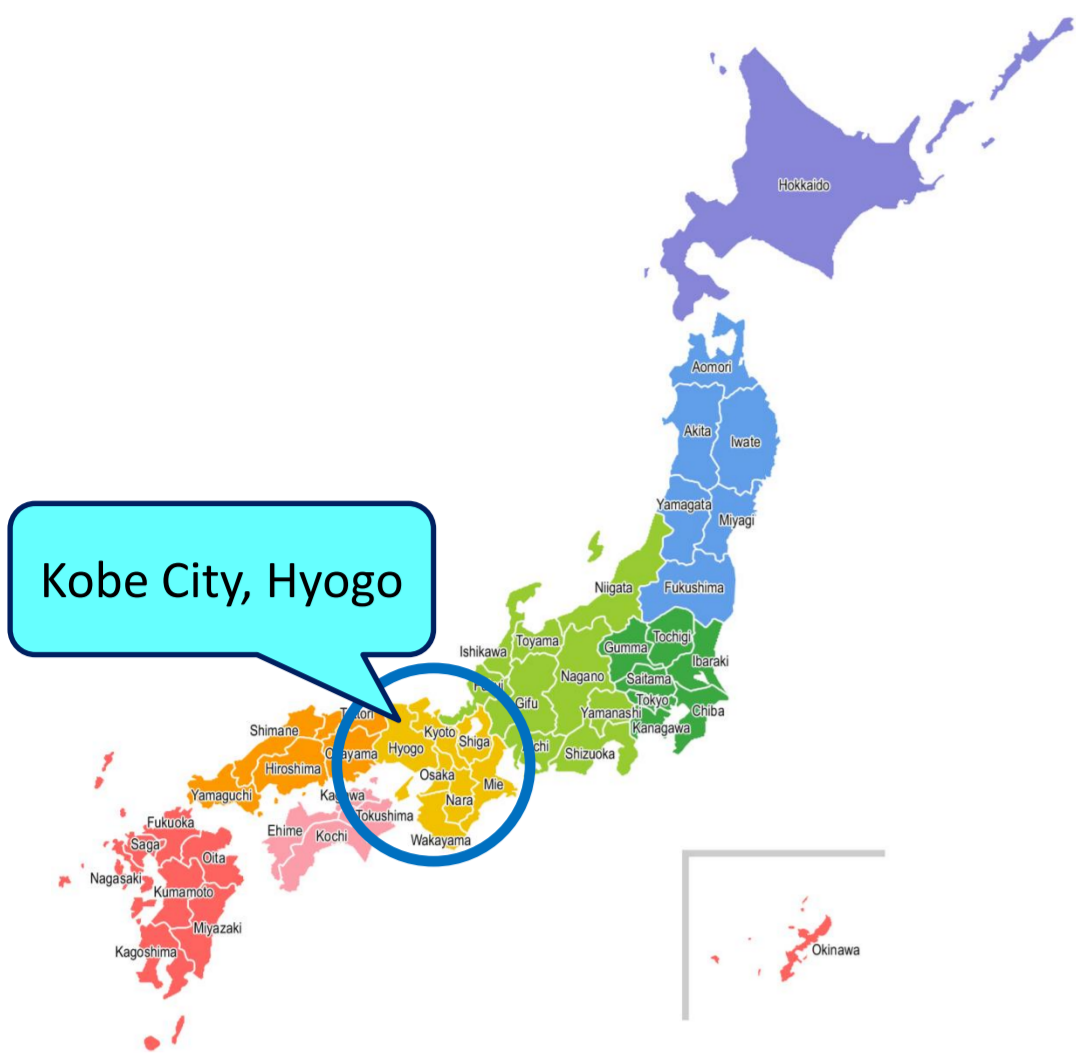1 Kobe City Medical Center Central Hospital, Department of Nursing, Department of Infection Control
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Kobe City Medical Center General Hospital

Kobe City, Hyogo

- 768 beds
- Designated as a Core Hospital in the region
- 2000 outpatients/day
- The average length of stay: 10.4 days (FY2017)
- Moved to a new hospital in July 2011

19 operating rooms
- Appx.12,500 surgical cases / year (FY2017)
- 541 cardiovascular surgical cases

Background

- A cardiovascular surgery is highly invasive by nature. In addition, due to the aging of patients and the advancement of complex procedural techniques, high-risk patients are increasing in number. Therefore it is extremely important to take appropriate Surgical Site Infection (SSI) prevention measures and continuously monitor its occurrence.

- In our hospital, SSI prevention measures have been implemented since 2008 in partnership between Cardiovascular Surgical Service and Department of Infection Control. The hospital moved to a new location in July 2011, which resulted in big changes in the operating room environment. The SSI measures were continued in the new hospital, yet we didn't investigate causes of SSIs nor monitor compliance with the SSI measures.

Objective

- To identify causes of SSI occurrence including compliance with SSI Prevention Bundle in order to prevent SSI after cardiac surgery.

METHOD

Study design:	Retrospective cohort study

Inclusion criteria:	• Patients who received cardiac surgery during Period Ⅰ and Period Ⅱ
	  - Period Ⅰ : from January 2008 to December 2010 (Infection control measures were started.)
	  - Period Ⅱ : from January 2014 to December 2016 (Infection control measures were reinforced.)

Exclusion criteria:	• Patients <20 years of age • Patients whose death was confirmed during the follow-up
Operative method	CARD/CABG/TAA/Complex surgery

Outcomes	• SSI occurrence
	• Case determination by CV surgeons and ICN based on the CDC definition
	• Including followings;
	  - Superficial incisional SSI
	  - Deep incisional SSI
	  - Organ/Space SSI(mediastinitis, graft infection and others)

Follow-up periods:	Superficial SSI within 30 days, Deep, Organ/Space SSI within 1 year
Observation items:	Pre-, intra-, post-operative risk factors for SSI
SSI Bundle:	1) Prophylactic antibiotic within one hour before incision 2) Appropriate prophylactic antibiotics(Cefazolin or Vancomycin) 3) Antibiotic discontinuation within 72 hours after a surgery 4) Glucose control on post-operative day 1 morning(<160mg/dL) 5) Glucose control on post-operative day 2 morning(<160mg/dL) 6) Hair removal with clipper 7) Normothermia just after surgery (≧36℃)

Analytical method:	• Comparison between Period Ⅰ and Ⅱ for adherence to the SSI prevention bundle after descriptive statistics
	• -Univariate analysis by risk factor
	  -t-test or Wilcoxon test in case of continuous variables
	  -χ²test or Fisher's exact test for ordinal variables
	• Multivariate analysis with multiple logistic regression
	• JMP13.0 for statistical analysis

Ethics:	Approved by the hospital Internal Review Board

SSI Prevention measures during the study

Pre-operative	Hair removal with clipper * Shower on a day before surgery Surgical scrubbing Pre-operative dental consultation and oral care MRSA screening in nare and decolonisation of positive patients
Intra-/post-operative	Glucose control (<160mg/dl post-operative) * Prophylactic antibiotic protocol* 　• Administration of 1〜2g of Cefazolin within 1 hour before incision and every 3 hour during a surgery 　• Discontinue within 72 hours 　• Intraoperative administration of 1g of Vancomycin for MRSA positive patients 　• Combination of Cefazolin and Vancomycin in case of emergency operation Regular exchange of gloves and double gloving during a surgery Prevention of low body temperature* Additional cap to cover ears / hair Coating of surgical drapes with INTEGUSEAL Early removal of drains

*recommended by prevention bundle
Red color indicates prevention measures which were added.
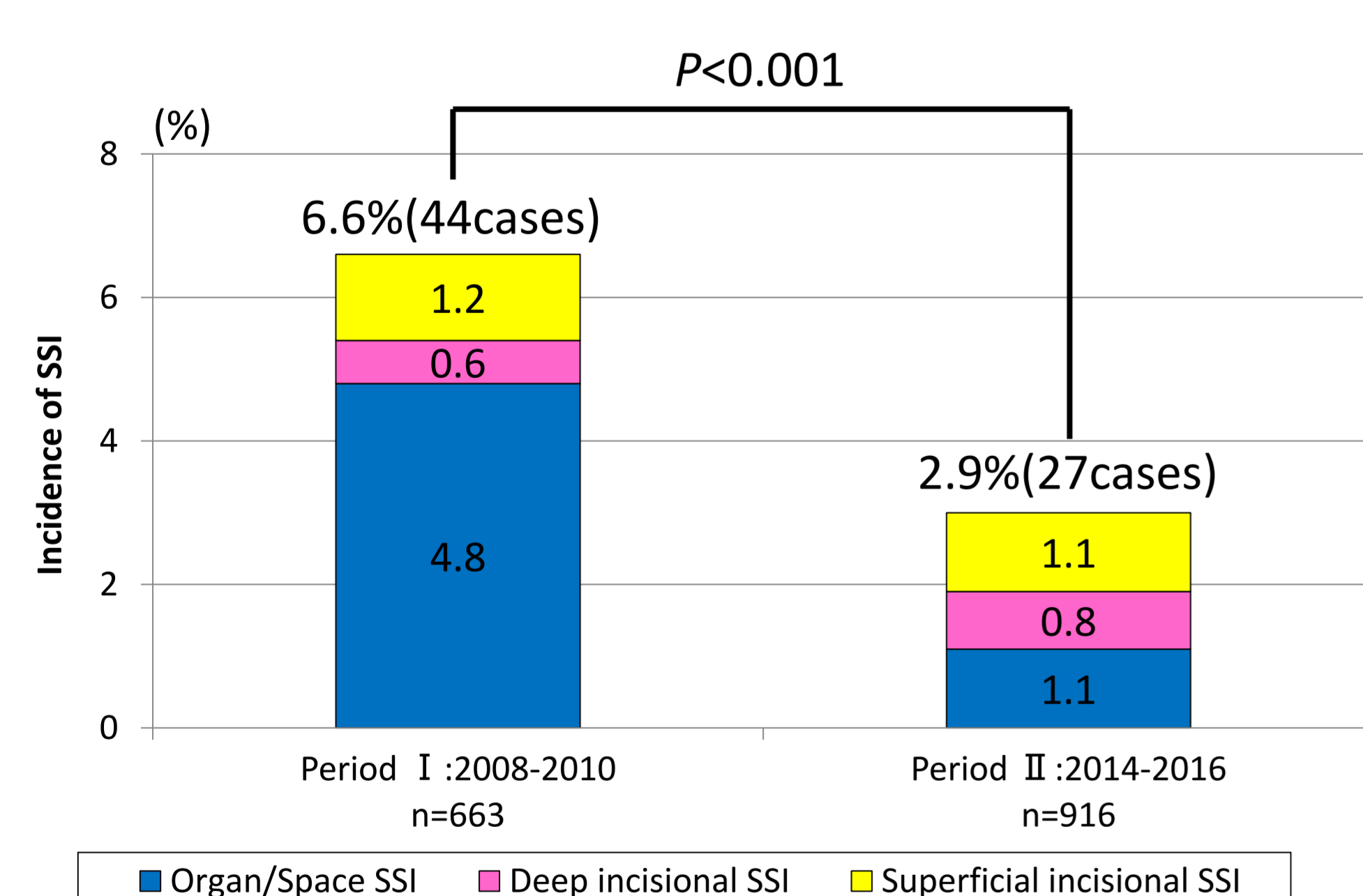
RESULT

Characteristics of subjects

Variables	Subjects (n=1579)
Age, mean±SD	68±12
Men, n(%)	971(61)
BMI, mean±SD	23±3.6
Surgical procedure CARD/CABG/TAA/Complex surgery	700/384/218/276
ASA score≧3, n(%)	1240(78)
Smoking, n(%)	792(50)
Diabetes, n(%)	418(26)
Dialysis history, n(%)	93(6)
Operative duration, median(IQR)	377(308-455)
Post- operative glucose level Day 1 morning, mean±SD	144±26
Post- operative glucose level Day 2 morning, mean±SD	140±31

Incidence of SSI

P<0.001

6.6%(44cases)
- 1.2
- 0.6
- 4.8

2.9%(27cases)
- 1.1
- 0.8
- 1.1

Period Ⅰ :2008-2010 n=663
Period Ⅱ :2014-2016 n=916

■ Organ/Space SSI   ■ Deep incisional SSI   ■ Superficial incisional SSI

SSI bundle implementation rate by surgical period

SSI bundle, n (%)	Total (n=1579)	Period Ⅰ 2008-2010 (n=663)	Period Ⅱ 2014-2016 (n=916)	Pvalue
Administration of prophylactic antibiotics within 1 hour of incision	1253(80)	518(79)	735(80)	0.026
Appropriate antibiotic selection	1563(99)	650(98)	915(99.9)	<0.001
Discontinuation of antibiotics within 72 hours after surgery	1268(83)	442(69)	826(93)	<0.001
Post-operative day 1 morning glucose level < 160mg/dl	1231(78)	458(73)	746(82)	<0.001
Post-operative day 2 morning glucose level < 160mg/dl	1245(79)	473(71)	772(85)	<0.001
Core temperature when leaving OR≧ 36℃	1379(87)	579(87)	800(87)	1.00
Using clippers for surgical site hair removal	1579(100)	663(100)	916(100)	—
100% compliance with the Bundle	582(38)	179(27)	412(45)	<0.001

X²-test

Univariate analysis of variables associated with SSI

Variable	SSI (n=71)	Non SSI (n=1508)	Pvalue
Age≧65	45(63)	1032(68)	0.37
Men	49(69)	922(61)	0.18
ASAscore≧3	57(80)	1183(78)	0.71
Smoking	41(58)	751(50)	0.19
Diabetes	13(18)	405(27)	0.11
Dialysis history	7(10)	86(6)	0.19
Surgical period (Period Ⅱ)	27(38)	889(59)	<0.001
Re- open heart surgery	4(6)	31(2)	0.069
Intra-operative bleeding≧486(ml)	43(61)	747(50)	0.069
Operative duration≧5hour	65(92)	1165(74)	0.0052
glucose level Post-operative day 1 morning	149±31	144±26	0.065
glucose level Post-operative day 2 morning	147±35	140±31	0.042
SSI bundle, n (%)			
Administration of prophylactic antibiotics within 1 hour of incision	48(68)	1205(80)	0.0095
Appropriate antibiotic selection	70(99)	1493(99.5)	0.34
Discontinuation of antibiotics within 72 hours after surgery	53(75)	1238(82)	0.11
Post-operative day 1 morning glucose level< 160mg/dl	50(70)	1181(78)	0.11
Post-operative day 1 morning glucose level< 160mg/dl	48(68)	1197(80)	0.014
Core temperature when leaving OR≧36(℃)	57(80)	1322(83)	0.068
Using clippers for surgical site hair removal	71(80)	1508(100)	—
100% compliance with the Bundle	15(21)	576(38)	0.0037

Mann-Whitney U-test, or X²-test

Logistic regression analysis of variables associated with SSI

Variable	Odds ratio	95% CI	Pvalue
Age≧65 years old	0.78	0.46-1.3	0.27
Men	1.3	0.72-2.2	0.26
Operative duration≧5 hour	2.2	0.85-5.8	0.14
Surgical period (Period Ⅱ)	0.41	0.23-0.71	0.0061
Surgical procedure			
CARD	reference	-	-
CABG	1.1	0.54-2.3	0.91
TAA	1.5	0.63-3.4	0.30
Multiple procedures	2.5	1.3-4.8	0.012
Bundle			
Administration of prophylactic antibiotics within 1 hour of incision	0.57	0.33-0.97	0.040
Discontinuation of antibiotics within 72 hours after surgery	1.03	0.56-1.9	0.59
Post-operative day 1 morning glucose level <160mg/dl	0.77	0.44-1.3	0.43
Post-operative day 1 morning glucose level <160mg/dl	0.74	0.42-1.3	0.30
Core temperature when leaving OR ≧36℃	0.6	0.32-1.2	0.14

CI, confidence interval ; ASA, American Society of Anesthesiologists ; CARD, cardiac surgery ; CABG, coronary artery bypass graft ; TAA, thoracic aortic aneurysm.

DISCUSSION

Compliance with SSI prevention Bundle

- To study effectiveness of the SSI prevention measures after the hospital relocation, compliance with the SCIP SSI bundle was evaluated.

  National Surgical Infection Prevention Project (SIP)

- A systematic review on effectiveness of the SSI prevention bundle showed odds ratio of 0.82 when adherence improved.

  Am J Surg.208(5):835-40.2014.

- In our study, SSI rate significantly decreased in Period Ⅱ when adherence to Bundle increased. This indicates improved Bundle compliance contributed to reduction in SSI.

- Other factors might be associated to SSI decrease in Period II such as changes in the environment and HCWs, introduction of new infection control measures and difference in patients background.

Administration of prophylactic antibiotic within 1 hour before incision

- A purpose of antibiotic prophylaxis is to prevent SSI. Selection of drug, dose, timing and duration of administration is important.

- Antibiotic needs to reach a therapeutic level of blood and tissue concentration at a start of surgery. A recommended timing of administration is within 1 hour before incision.

  Am J Health Syst Pharm. 70(3) : 195-283, 2013.

- Compliance with the recommendation was 80% and 20% of cases exceeded 1 hour.

- Administration timing could be a challenge in a cardiac surgery as it requires numerous preparation steps prior to start. Good coordination with a surgical team is essential to improve compliance .

CONCLUSION

Conclusion

- Multiple procedures in a surgical case carries high risk for SSI in cardiac surgery . Period Ⅱ which showed better adherence to SSI Bundle and a start of prophylactic antibiotic within 1 hour before incision lowered SSI risks.

- The results indicate importance of improved SSI Bundle adherence and administration of prophylaxis within 1 hour before incision.

Study Limitations

- The study results are based on experiences at a single center. Results could be different in other centers due to different patient popultation and surgical factors.

- It was not monitored when prophylactic antibiotic administration finished. Recommendation is to complete administration prior to incision. Investigation and analysis of finish time is a future task.

Future Tasks

- Detailed analysis of non-compliant cases of prophylaxis timing exceeding 1 hour before incision

- Optimization of prophylactic administration timing and preparation of a written procedure in collaboration with a surgical team

- Continuous monitoring and evaluation